Newcomers to a class often find they have good speed at times but at others they are struggling to get the boat going. Their speed is erratic and their mind is diverted from the job of racing and onto fiddling with the controls on the boat. Tactics often offer greater gains than boatspeed but with good boatspeed you'll appear to be a tactical genius! With boatspeed not only do you work yourself into a position where it's easier to make your own tactics than to have them dictated to you, but when the boat is going well you are also at liberty to focus on the tactical side of the race. You are then more likely to capitalise on tactical opportunities as they occur around the course.

So boatspeed is essential. On boats with a small number of crew, the speed must be obtained easily so the majority of effort can be put into the other race-winning skills.

There are basically three aspects that contribute to boatspeed:

- **Technique**
- **Rig**
- **Hull**

This list also represents a fair order of importance, although as sailing becomes ever more competitive it is difficult to succeed with the best technique in the world but the wrong equipment. I put technique at the top to remind us that a bad workman shouldn't blame his tools! Technique merges into hull preparation but more significantly the way in which we set up and tune the rig. The best sails and spars set up poorly offer no real advantage at all.

In this section I'll concentrate on the rig and assume that we are sailing a competitive boat which is down to minimum weight and has a well-prepared rudder and keel. I'll aim to cover the theory of the 7/8 rig as seen in slightly varying forms on the majority of small one-design racing keelboats such as Solings, Etchells and Melges 24s, and I'll touch on the fractional rig incorporating runners and checkstays. The aim is to go beyond simply being able to set up the rig according to the tuning guide (as supplied by the leading sailmakers) and be able to understand the theory behind the set-ups. The tuning guides represent a very good starting point and in many cases you will find that you hardly deviate from them. But understanding the theory will enable you to diagnose problems and rectify them as conditions change. Hopefully you will find that you are changing the settings of the rig to those in the tuning guides, as the conditions change, but not just because the guide says that is what you should do but because you understand how to cure a symptom, such as poor pointing or lack of power.

THE 7/8 RIG

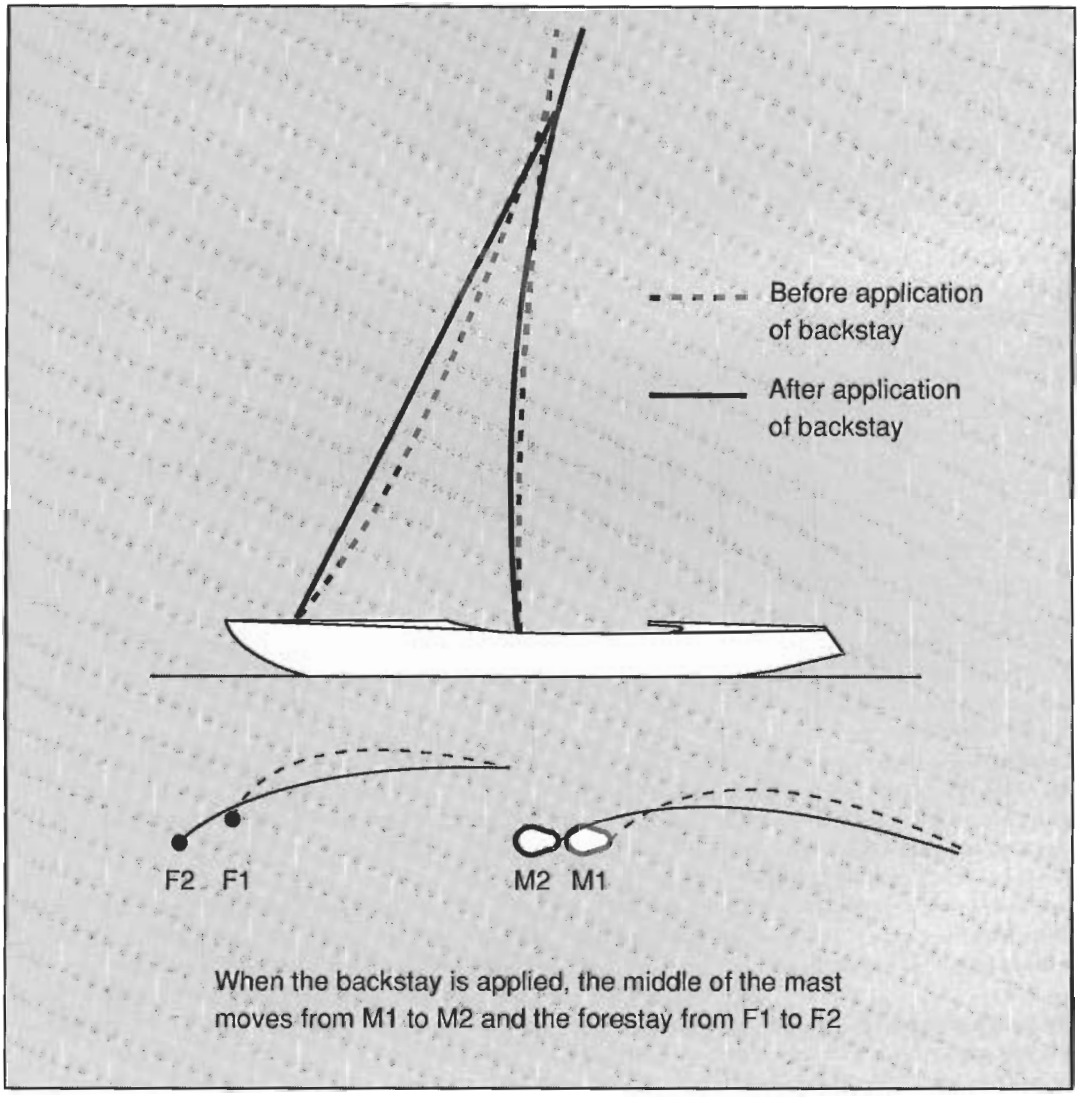
The concept of the 7/8 rig

The basic principle of the 7/8 rig is that as the backstay is adjusted it has an effect on both the jib and the mainsail shape by adjusting the mast bend and forestay sag. As the wind increases the backstay is tensioned. This has the effect of tightening the forestay and bending the mast. Tightening the forestay flattens the jib and bending the mast flattens the mainsail. The backstay is therefore the most important control line on the boat, after the sheets themselves.

The extent to which the mainsail and jib are altered by the backstay, and the proportions in which the mast is bent and the forestay tightened are determined by the rake, rig tensions, spreader angle and shroud positions (and heel and deck chocking positions if relevant). The object is to aim for an adjustment of the backstay to change the shape of both sails in the desired way.

Basic rig controls and setup

Rake – the rake determines the angle, fore-and-aft, at which the mast sits in the boat. In basic terms it controls the position of the centre of effort of the rig. Think of a windsurfer: if he tips the rig forward the centre of effort moves forward and the board bears away. On a keelboat this would show up as lee helm. Conversely, if the rig is moved aft then the centre of effort

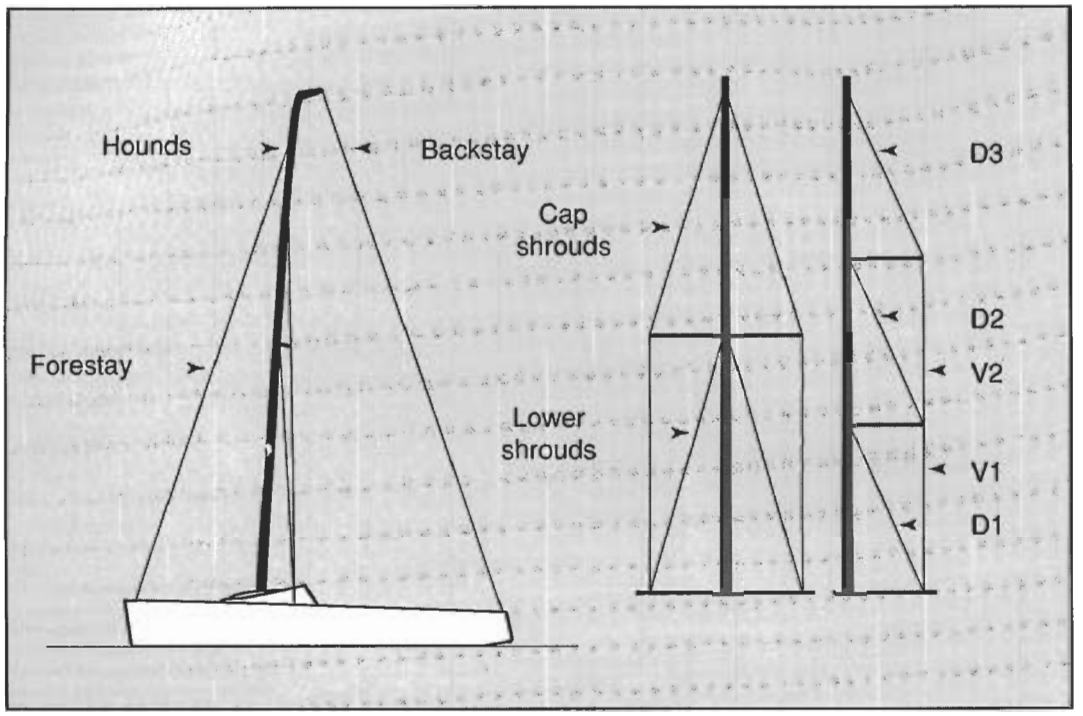


When the backstay is applied, the middle of the mast moves from M1 to M2 and the forestay from F1 to F2

moves aft causing a board to head up and a keelboat to develop weather helm.

On dinghies the centre of resistance, about which the centre of effort exerts a force, can be moved fore-and-aft by adjusting the centreboard. On a keelboat the centre of resistance can only be moved subtly, by adjusting the position of the crew weight.

Conventional theory maintained that as the wind strengthened the rake should be reduced (mast tip moved forward) to counteract the increase in weather helm brought about by the heeling of the boat. (As a conventional hull heels the leeward bow is pressured and its shape tries to force the boat into the wind.) This theory has been modified as sailors have learned the importance of keeping the boat at the correct angle of heel, thereby making the hull and keel more efficient. Nowadays as the wind increases the mainsail tends to be twisted open, and although the jib is also twisted, the effect on the centre of effort of the mainsail's twist is greater and than that of the jib's. The resultant twist in the sail plan actually moves the centre of effort



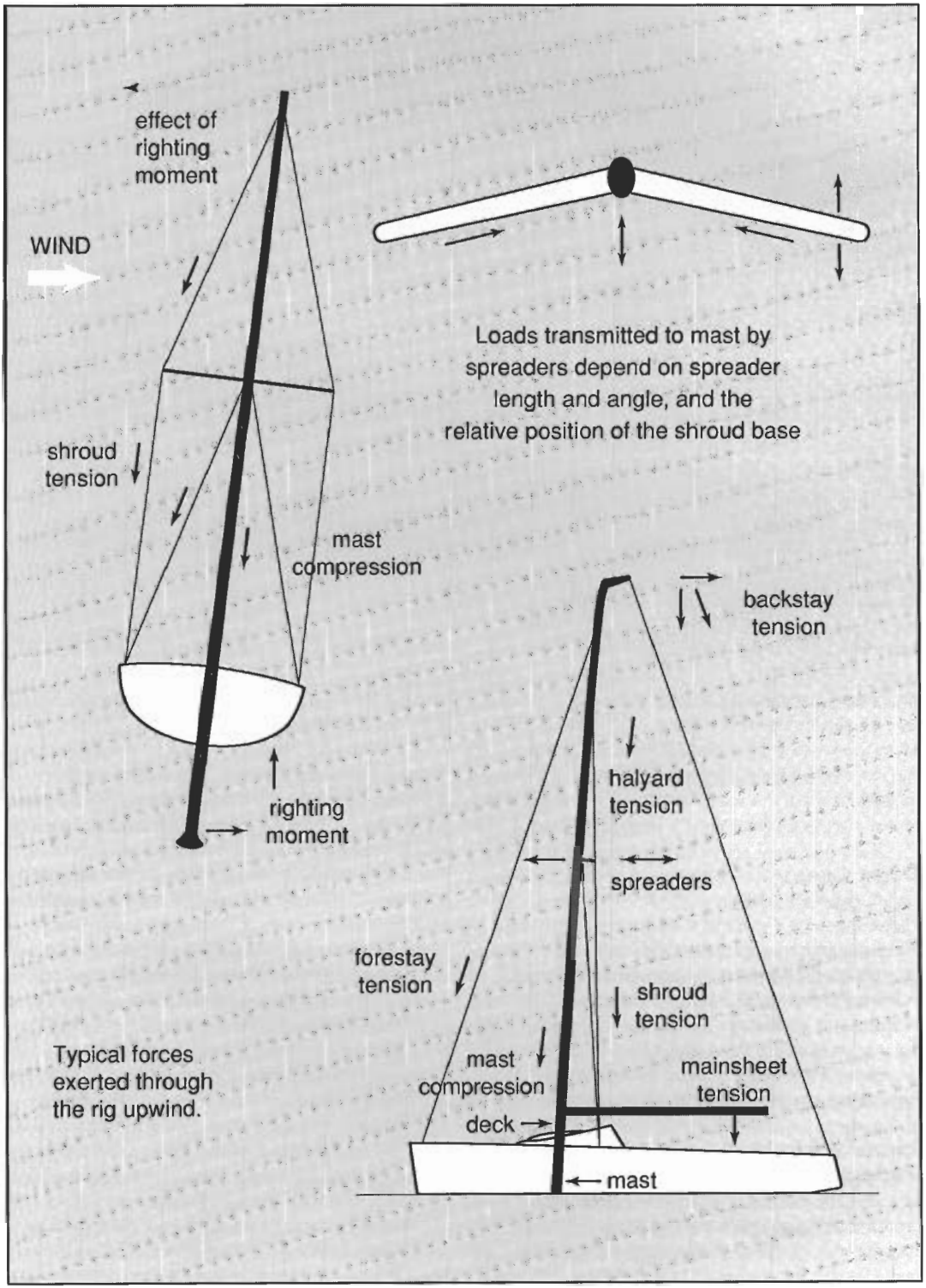
forward as the leech of the mainsail exerts less pressure. To counteract this the rake on the rig is increased (the tip of the mast is moved aft) and the balance of the boat is maintained. Another way of looking at it is to say that by increasing the rake then it is not necessary to sheet the main as hard to achieve the correct level of pressure on the helm.

The cap shrouds – control the position of the hounds above the boat and therefore the amount to which the rig falls off to leeward when the boat is going upwind. Depending on the position of the chainplates (attachment of shrouds to deck) and the relative angle and length of the spreaders, they also have an effect on the forestay tension and fore-and-aft mast bend. Working with spreader length and angle, and lower shroud tension, they also have an effect on athwartships bend. The tension on the shrouds is one determinant (along with the mainsheet, halyard loads, and backstay) of the compression in the mast and therefore the extent to which it will bend.

The lower shrouds – depending on the position of the chainplates the lower shrouds have an effect on both the athwartships bend and the fore-and-aft bend of the mast.

If the shrouds are in line and abreast of the mast then the effect on the athwartships bend will be the significant issue. In this case the lower shrouds are used to counteract the inward load on the mast exerted by the windward spreader. As a general rule the lower shrouds are tensioned to a point where the mast is straight athwartships. To check for this you should sight up the forward or aft edge of the mast. On such a rig the lower shrouds may be wound off in light conditions to allow the middle of the mast to sag to leeward (and thereby induce some fullness into the middle and bottom of the mainsail) and conversely they may be wound on in heavy conditions to flatten the middle and base of the mainsail and to allow the top of the rig to fall off (sag to leeward).

Conversely, if the chainplates are swept aft then the lower shrouds will will have a major effect on the fore-and-aft bend of the mast. The greater


effect of
righting
moment
WIND
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Loads transmitted to mast by
spreaders depend on spreader
length and angle, and the
relative position of the shroud base
backstay
tension
halyard
tension
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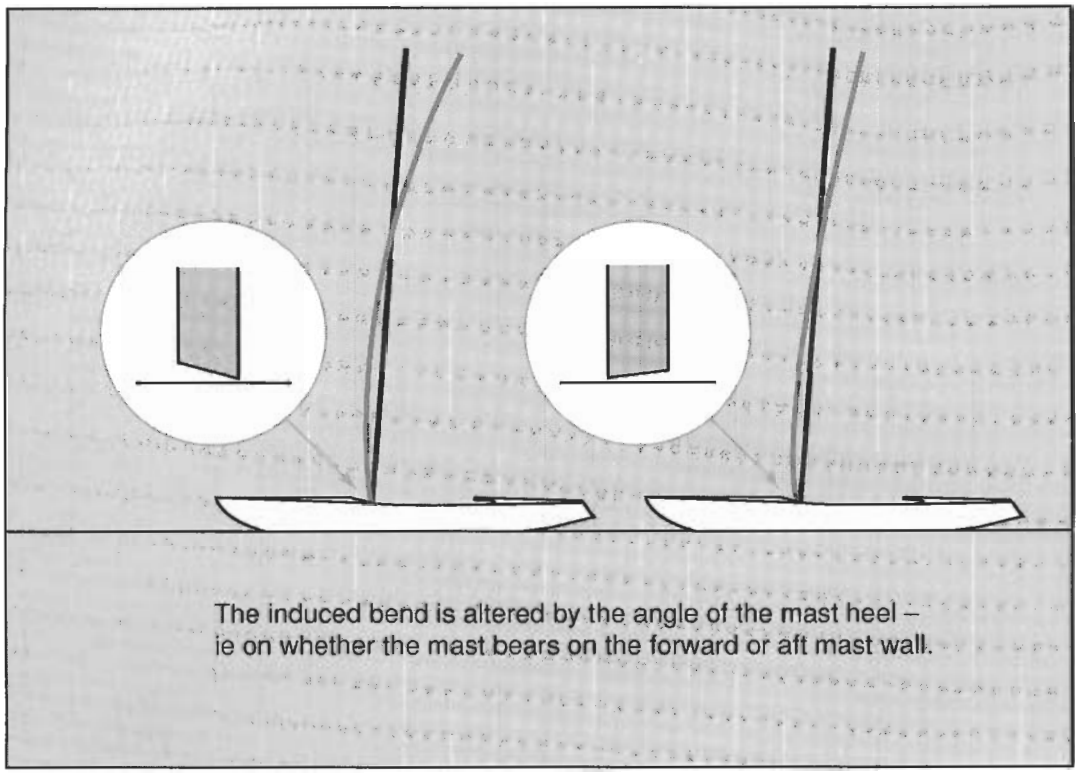
deck
mast
Typical forces
exerted through
the rig upwind.



The induced bend is altered by the angle of the mast heel – ie on whether the mast bears on the forward or aft mast wall.

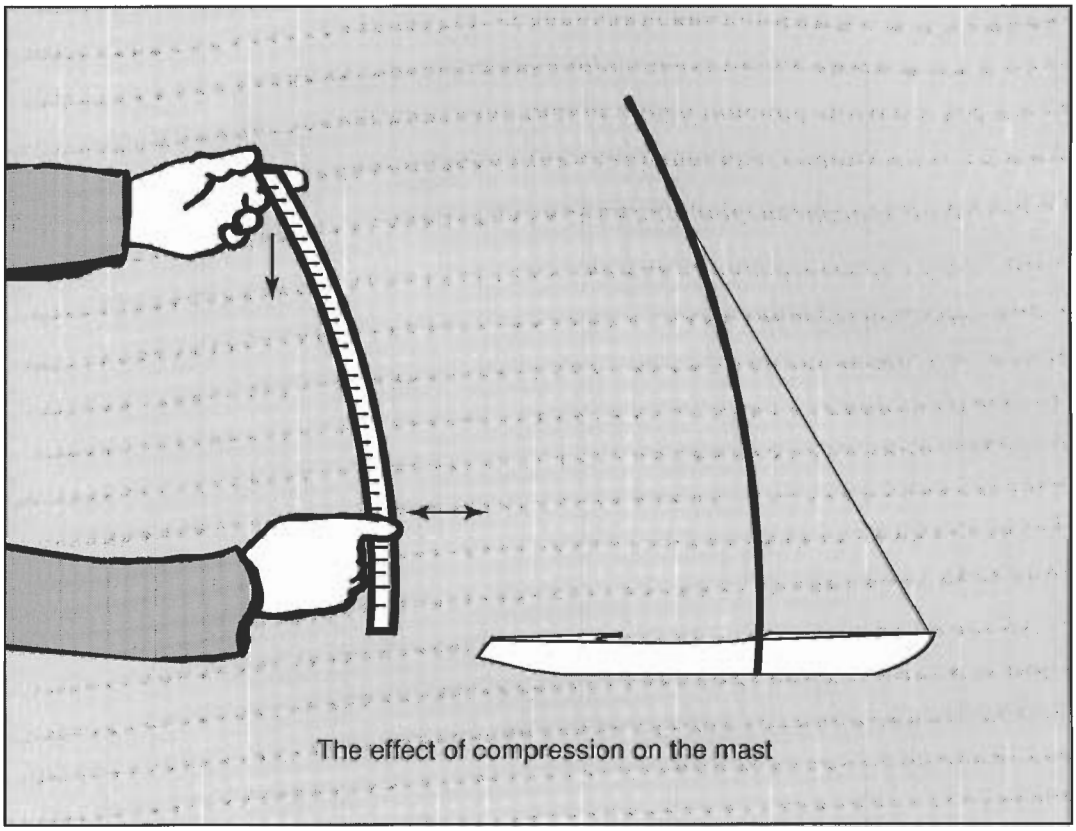
the sweep back the more pronounced this factor will be. On boats where the shroud base is well aft of the mast, such as the J24 and Melges 24, the lower shrouds are used to control the fore-and-aft bend of the mast and this is the dominant factor as we will see later.

D2's – These refer to the diagonal shrouds which run from the tips of the first set of spreaders to the roots of the second spreaders on two (or more) spreader rigs such as the Mumm 30. (The lower shrouds are sometimes referred to as the D1's on such boats.) These diagonal shrouds have a similar effect on the upper panel of the mast (the area of the mast between the first and second spreaders) as the lower shrouds do on a single spreader rig.

Spreader angle – The angle of the spreaders affects the stiffness of the middle of the mast fore-and-aft, and as a result also has an effect on the tension of the forestay. When the backstay is tensioned, forward-swept spreaders resist the mast-bending effect so the tension is transferred to the forestay, keeping it and the jib luff straight.

Spreader length – The spreader length affects the load exerted inwards on the middle of the mast. Generally speaking, if the spreaders are too long then the mast will sag to leeward in the middle. If the spreaders are too short then it will be difficult to prevent the top of the mast from falling off. Ultimately, if the spreaders are too short the mast will fall down because the angle from the spreader tip to the hounds is too acute to provide support. It is also worth considering that if you decide to increase the length of your spreaders then, if all other factors remain the same, you will require an increase in lower tension in order to keep the mast straight athwartships. This may or may not be a good thing depending on what you are trying to achieve.

Mast heel angle – This is often overlooked and is particularly important on deck-stepped masts. Firstly it is important that the heel of the mast is square sideways (and that plate or T that



The effect of compression on the mast

the masts sits on is level). If this is not correct then an athwartships set (permanent bend) will be found in the mast when the port and starboard side shrouds are at the same tension.

The fore-and-aft angle of the heel has an effect on the fore-and-aft stiffness of the mast.

If the mast is tending to sit on its aft edge then fore-and-aft pre-bend will be induced into the rig and the mast may tend to pump (flex fore-and-aft) when going through a seaway. Conversely, if the mast sits on its forward edge then it will be stiffer forwards but ultimately, if the angle is extreme, will have a tendency to invert (middle of the mast flexing aft). Although from a structural point of view it is best if the mast sits squarely on its heel (especially on large yachts), in small one-designs playing with the heel angle is a useful way of adjusting the bend characteristics of the mast, particularly on deck-stepped rigs. How you may wish to modify the heel will depend on the characteristics of the mast and the cut of the sails you are using.

Heel position and chocking at deck level – The heel position of the mast will have an effect on the balance of the boat and this will be felt by the relative helm (weather or lee). Moving the heel aft will tend to increase the weather helm and vice versa. This is simply because the centre of effort of the boat (the sail plan of the boat) is moving aft relative to the centre of lateral resistance (the hull and foils) which are staying constant.

On boats such as J24's and Etchells (where the mast is keel-stepped) the heel position, relative to the holding of the mast at deck level, has a significant effect on bend characteristics of the mast. Before trying to explain the interactive effect the mast heel and deck chocking have on the rig I suggest that you get a twelve inch plastic ruler and carry out the following exercise.